Single-source-of-truth coordination of hardware/software development

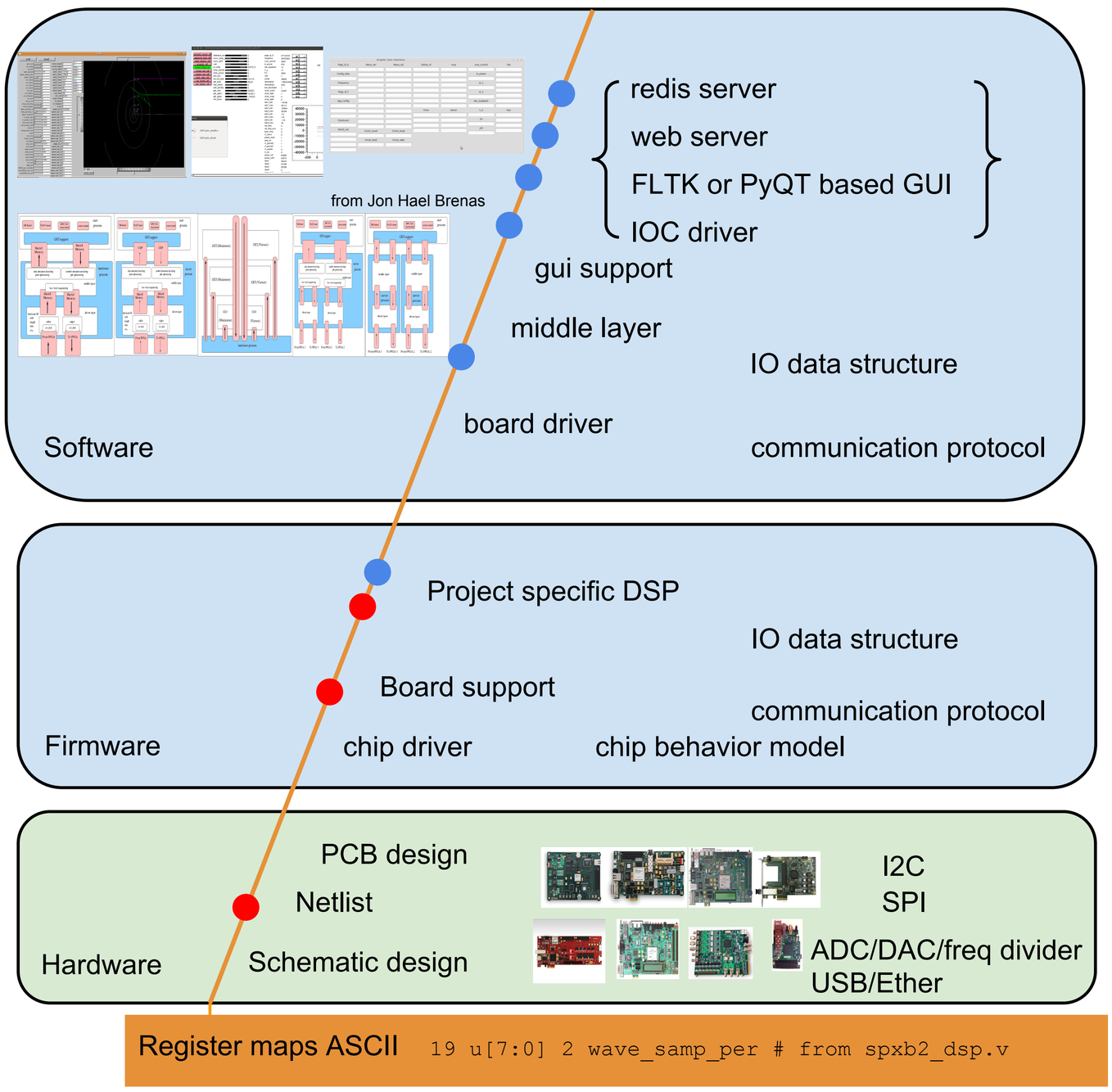
Gang Huang[1], Carlos Serrano[1], Lawrence R Doolittle[1]

[1]Lawrence Berkeley National Laboratory, Berkeley, CA 94720

Abstract

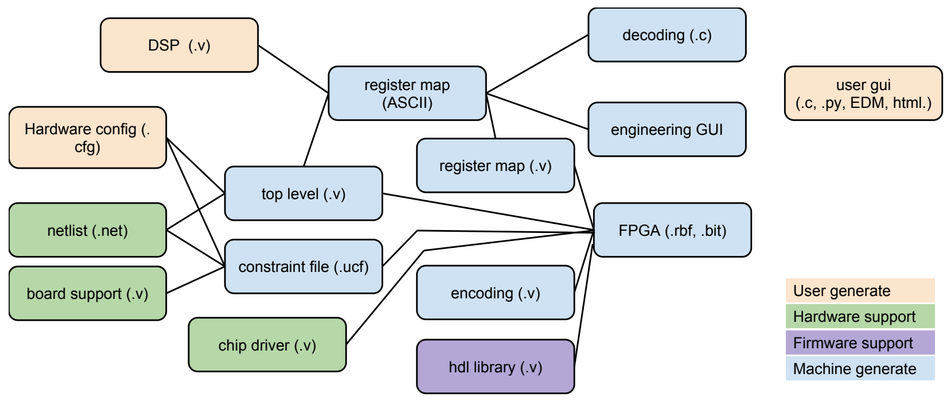
A control system is made of hardware, firmware and software. The same feature set may target more than one hardware platform, sometimes involving mother/daughter board sets. The firmware includes hardware drivers, board support, communication, data structure de/encoding, and digital signal processing modules. The software design will include communication, data structure en/decoding, a GUI support layer, and connection to global controls. The same information is needed by many of these layers, but are traditionally represented differently. We have developed processes and structures to extract all needed information from a single human readable source, and use it during firmware design, synthesis, low level software generation, creation of expert screens, and more. In this workshop, we present our progress and experience using and improving this structure through application to multiple projects.

A concept



- NO information entered by a human more than once throughout project
- Machine-generated engineering GUI
- DSP IO named after hardware
- Multi-hardware multi-GUI capability
- One name from top to bottom
- Source of truth
  - Collected from
    - hardware configuration (netlist)
    - board support package
    - application-specific DSP
  - Transparently transported
    - packed in IO data structure
    - stream mode or inquiry mode
    - communication protocol
    - USB or UDP
  - Consumed in
    - firmware simulation
    - firmware synthesis
    - software decoding
    - engineering GUI
    - data archiver
    - global controls database
  - Represented in
    - Human readable format
    - ASCII for now

A collection of software tools



history of projects evolving the concept

- SNS LLRF system
- LCLS fs timing system
- FERMI@Elettra LLRF/timing
- Advanced Photo-injector EXperiment Gun LLRF/laser control
- Short Pulse X-ray in APS

Conclusion

Single-source-of-truth is a concept to improve system consistency. We have implemented it by writing a collection of software tools that connect different layers. We learned the concept from our experience managing related projects, and we are still refining the tools to make the system more capable and flexible.